**Supplemental Text**

**Climate change communicators’ carbon footprints**

**affect their audience’s policy support**

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# **Sample Differences**

In the current paper (Study 1): In May 2017, 3646 participants were recruited on MTurk and completed the survey. Each received on completion a $1.50 gift certificate to Amazon.com.Median age was 34 years, with 48% male. They were well educated, with 70% having some college or a college degree, and an additional 20% with some graduate education or graduate degree. The participant group was politically liberal, compared to the general U.S. population: about 40% identified as liberal or extremely liberal, and only about 14% as conservative or extremely so.

In the current paper (Study 2): In March 2016, 1772 participants were recruited on MTurk and completed the survey. Each received on completion a $1 gift certificate to Amazon.com. Median age was 32 years, with 54% male.

In the Attari et al. (2016) study: In October 2014, we recruited 2028 participants via Amazon’s Mechanical Turk (MTurk) Internet panel who completed the survey online. Each participant received a $3 gift certificate to Amazon.com on completion. Mean age was 34 years and 51% of participants were male. The mean family income was $20,000–$40,000 and mean education was some college experience. Fifty-four percent self-identified as liberals, 25% as moderates, and 21% as conservatives.

# **Additional Analysis**

## **Analysis of reported intentions to conserve energy**

### **Table S1:** Coefficients for logistic regression models for reported intentions (Original 2016 results)

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Coefficient* | *scale of variable* | *Less Home Energy* | *Fly Less* | *More Public Transport* |
| *estimate* | *s.e.* | *estimate* | *s.e.*  | *estimate* | *s.e.*  |
| **Intercept** | logit scale | −1.040 | *.238* | −1.653 | *.219* | −1.787 | *.225* |
| **Age** | 18 – 76 yrs | −0.004 | *.003* | +0.009 | *.003* | −0.011 | *.003* |
| **Education** | 1 – 6 scale | +0.087 | *.033* | −0.133 | *.029* | +0.120 | *.029* |
| **Gender** | 0 = female1 = male | −0.275 | *.070* | +0.259 | *.063* | +0.308 | *.064* |
| **Income** | 1 – 7 scale | +0.051 | *.030* | −0.112 | *.027* | −0.089 | *.028* |
| **Political Orientation** | 1 – 7 (liberal to conservative) | −0.008 | *.024* | −0.017 | *.022* | −0.127 | *.022* |
| **Climate Chg Importance** | 1 – 4 (not at all to very) | +0.485 | *.046* | +0.442 | *.043* | +0.469 | *.045* |
| **Researcher Credibility** | −1 to +1 scale | +1.411 | *.077* | +0.920 | *.074* | +0.503 | *.074* |

### **Table S2.** Coefficients for logistic regression models for reported intentions, replicating the model used in 2016 study

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Coefficient* | *scale of variable* | *Less Home Energy* | *Fly Less* | *More Public Transport* |
| *estimate* | *s.e.* | *estimate* | *s.e.*  | *estimate* | *s.e.*  |
| **Intercept** | logit scale | -0.954 | *.279* | -1.212 | *.260* | -1.210 | *.276* |
| **Age** | 18 – 86 yrs | −0.002 | *.003* | +0.014 | *.003* | −0.010 | *.003* |
| **Education** | 1 – 6 scale | +0.007 | *.036* | −0.187 | *.033* | +0.079 | *.033* |
| **Gender** | 0 = female1 = male | −0.315 | *.080* | −0.004 | *.072* | +0.168 | *.075* |
| **Income** | 1 – 7 scale | +0.070 | *.036* | −0.114 | *.032* | −0.099 | *.034* |
| **Political Orientation** | 1 – 7 (liberal to conservative) | −0.020 | *.026* | −0.007 | *.024* | −0.184 | *.026* |
| **Climate Chg Importance** | 1 – 4 (not at all to very) | +0.537 | *.053* | +0.371 | *.052* | +0.378 | *.056* |
| **Researcher Credibility** | −1 to +1 scale | +1.014 | *.095* | +0.672 | *.088* | +0.567 | *.094* |

### **Table S3:** Coefficients for logistic regression models for reported intentions, replicating using a new model including influence

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| *Coefficient* | *scale of variable* | *Less Home Energy* | *Fly Less* | *More Public Transport* |
| *estimate* | *s.e.* | *estimate* | *s.e.*  | *estimate* | *s.e.*  |
| **Intercept** | logit scale | -1.938 | *0.363* | -1.827 | *0.346* | -1.705 | *0.376* |
| **Age** | 18 – 86 yrs | -0.001 | *0.003* | +0.014 | *0.003* | -0.010 | *0.003* |
| **Education** | 1 – 6 scale | +0.003 | *0.036* | -0.190 | *0.033* | +0.077 | *0.034* |
| **Gender** | 0 = female1 = male | -0.300 | *0.080* | +0.001 | *0.072* | +0.172 | *0.076* |
| **Income** | 1 – 7 scale | +0.066 | *0.036* | -0.115 | *0.032* | -0.101 | *0.034* |
| **Political Orientation** | 1 – 7 (liberal to conservative) | +0.024 | *0.028* | +0.016 | *0.025* | -0.166 | *0.027* |
| **Climate Chg Importance** | 1 – 4 (not at all to very) | +0.417 | *0.062* | +0.294 | *0.059* | +0.321 | *0.064* |
| **Climate Chg Happening** | 1 (definite N) to 4 (definite Y) | +0.141 | *0.072* | +0.093 | *0.073* | +0.098 | *0.082* |
| **Researchers influence policy** | 1 (Oppose) to 5 (Support) | +0.195 | *0.050* | +0.122 | *0.049* | +0.075 | *0.052* |
| **Researcher Credibility** | −1 to +1 scale | +0.855 | *0.103* | +0.567 | *0.095* | +0.497 | *0.101* |

## **Changes in the beliefs and attitudes about climate change**

The investigation of correlates for Researcher Credibility, intentions to conserve energy, and support for policies that aim to reduce CO2 emission led us to collect data on respondents’ political orientations, their beliefs that climate change is happening, and their attitudes toward climate change. We knew already that these latter variables are correlated: more conservative respondents are more likely not to believe that climate change is happening and not to care so much about it. This data collection occurred across 4 distinct surveys: Rep1 (October 2014) and Rep2 (December 2014) is data from Attari *et al.* (2016)1, Rep3 (March 2016) and Rep4 (May 2017) are data from the current study. A substantial shift occurred over time: liberals and moderates came to believe more strongly that climate change is happening and to care more about it, while conservatives changed their beliefs and their attitudes less clearly.

We analyze trends for climate change beliefs for our collected data (Rep1 - Rep4) by seven political orientation subgroups: very liberal, liberal, slightly liberal, moderate, slightly conservative, conservative, and very conservative. We focus our analysis on the following two questions:

1. How important is the issue of climate change to you personally?

☐ Very important

☐ Somewhat important

☐ Not too important

☐ Not at all important

2. Recently, you may have noticed that climate change has been getting much attention in the news. Climate change refers to the idea that the world’s average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world’s climate may change as a result. What do you think? Do you think that climate change is happening?

☐ Yes -- Definitely

☐ Yes -- Probably

☐ No -- Probably

☐ No -- Definitely



**Figure 1. shows the change in belief that climate change is happening, measured by the logarithm of the ratio of “Definitely Yes” to “Probably Yes” responses.**

We chose this measure because it applies well to each of the Political Orientation subgroups. The liberal subgroups give nearly 100% “Yes” responses, so only this ratio can show any change over time; and even the conservative subgroups produce about 50% “Yes” responses, though tending (as the graph shows) toward Probably rather than Definitely. For the three liberal subgroups (top of the figure) the change over time is statistically significant (LRT statistics = 17.4, 31.3, and 29.0, with 9 df for a conservative test). For the moderate and conservative subgroups the trend is similar but statistical significance is marginal. Note that the changes over time seem smaller than the overall differences among the subgroups.

**Figure 2 shows the change in personal importance of climate change as a function of political orientation.**

 

Shown is the plot of the logit of proportion of “Very Important” responses, as a function of time (abscissa) and of Political Orientation. We combine the three groups labelled conservative – from “somewhat” to “extremely” – because they apparently differ little. The largest observed difference for this combined group – between Survey 2, in December 2014 and Survey 4, May 2017 – shows an increase in “Very Important” that could be viewed as marginally statistically significant, but this is a *post-hoc* selection of the largest observed difference. Using a more conservative test (LRT statistic with 9 *df* across the 4 replications), this change is not significant at even the 10% level. (This is also the case for each of the 3 conservative groups taken separately). The other 4 groups shown in Figure 2 all increased somewhat in “Very Important” responses as shown

on the graph. The LRT statistic with 9 df was significant with p < 10-5 for each of these 4 groups.

# **Main Survey Instrument**

Overall design has 12 experimental conditions:

1. CCS x High carbon footprint
2. CCS x Low carbon footprint
3. Carbon tax x High carbon footprint
4. Carbon tax x Low carbon footprint
5. Nuclear power x High carbon footprint
6. Nuclear power x Low carbon footprint
7. Population control x High carbon footprint
8. Population control x Low carbon footprint
9. Renewable energy x High carbon footprint
10. Renewable energy x Low carbon footprint
11. Public transit x High carbon footprint
12. Public transit x Low carbon footprint

Dear Participant,

Please complete this survey on public policy issues. The survey is anonymous, and no one will know what answers you give. This brief survey should take no more than 15 minutes to complete.

Thank you for your time and help with this effort.

If you have any questions, please do not hesitate to send me an email at: survey.iub@gmail.com

Sincerely,

Dr. Shahzeen Z. Attari

[PAGE BREAK]

[Common language]

Please read the story below and then answer some questions:

You attend a talk by a leading climate researcher. He has been publishing scholarly articles about climate science since 1974 and has over 150 publications in leading journals, including *Science* and *Nature*.

The researcher explains that individual actions have a large collective impact on the environment. For example, air travel and high energy use at home have negative environmental effects. The researcher advises the audience to reduce energy use by flying less, using less energy at home, and using local public transportation. He goes on to say that while voluntary action by individuals is important, society must also modify public policies in order to reduce carbon dioxide emissions. His main policy recommendation is to

[Branches]

**regulate carbon dioxide as a pollutant:**

**tax carbon emissions:**

**increase nuclear power generation:**

**stabilize human population:**

**increase renewable energy:**

**increase support of public transit:**

[Branch CCS]

**Regulate carbon dioxide as a pollutant:** Society should regulate carbon dioxide as a pollutant**.** After a transition period, regulations will lead to improved technology for capturing large-scale emissions of carbon dioxide, which will be stored as solid rock (i.e., carbonate minerals) that will not return to the atmosphere for millions of years.

[Branch Tax]

**Tax carbon emissions:** Society should estimate the financial cost of carbon dioxide emissions and recover it from a revenue-neutral tax on gasoline and on use of electric power. (Other taxes will go down equal to the increase from the new tax.) This tax would be adjusted up or down as the environmental cost of carbon dioxide emission changes over time.

[Branch Nuclear]

**Increase nuclear power:** Society should resume construction of nuclear power plants using the best current technology for safety, efficiency and disposal of nuclear waste. New nuclear plants will replace coal-fired power plants.

[Branch Population]

**Stabilize human population:** Society should stabilize human population by promoting education and work opportunities for women and by lowering the cost of children’s education for parents who restrict themselves to no more than 2 births.

[Branch Renewable]

**Increase renewable energy:** Society should invest heavily in research to improve renewable energy (e.g., solar and wind power) and should also provide incentives for renewable energy industries to implement the discoveries that result from this research.

[Branch Public Transit]

**Increase public transit:** Society should reduce pollution from cars and trucks by investing strongly in infrastructure for public transportation, including rapid, convenient local rail and transit for people and energy-efficient transport of agricultural and manufactured products.

Participants would then see one of the following two carbon footprint vignettes:

[Low home carbon footprint]

During the question period a member of the audience asks the researcher how much energy he himself uses at home. He replies that he has a modest home with a low energy bill; he has switched to a slightly more expensive but green electricity provider, and has invested in energy-efficient appliances.

[High home carbon footprint]

During the question period a member of the audience asks the researcher how much energy he himself uses at home. He replies that he has a large home with a high energy bill; he has not yet switched to a slightly more expensive but green electricity provider or invested in energy-efficient appliances.

[Common Narrative]

As you think about the researcher’s advice, do you support or oppose <insert bold title here>?

\_Strongly support \_Support \_Neutral \_Oppose \_Strongly oppose

Based on the advice provided by the researcher, please check which of the following actions you would be willing to incorporate in your life. *(Check all that apply).*

☐ Fly less

☐ Use less energy in my home

☐ Take public transportation more often

☐ Think about changing some actions

☐ I already conserve energy

☐ Change no actions

☐ Other (please specify): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

[PAGE BREAK]

[CREDIBILITY measure]

Based on the previous paragraph, please indicate how strongly you agree or disagree with each of the following statements: [Shown in random order]

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
| I believe that the researcher’s behavior is consistent with his advice | **☐** | **☐** | **☐** | **☐** | **☐** |
| I believe the researcher’s advocacy is sincere | **☐** | **☐** | **☐** | **☐** | **☐** |
| I do not trust the researcher’s authority with respect to climate science | **☐** | **☐** | **☐** | **☐** | **☐** |
| I believe that the researcher has good reasons for his behavior | **☐** | **☐** | **☐** | **☐** | **☐** |
| I doubt the researcher’s credibility | **☐** | **☐** | **☐** | **☐** | **☐** |
| I believe that the researcher provides quality advice  |  |  |  |  |  |
| I believe climate researchers need to influence policy decisions that affect how society responds to climate change | **☐** | **☐** | **☐** | **☐** | **☐** |

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[Policy attitude measure]

Recall that the researcher recommended the following policy: [insert entire policy here]

Based on the policy, please indicate how strongly you agree or disagree with each of the following statements.

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
| This policy appeals to me philosophically | **☐** | **☐** | **☐** | **☐** | **☐** |
| This policy would be environmentally sound | **☐** | **☐** | **☐** | **☐** | **☐** |
| This policy would be economically sound | **☐** | **☐** | **☐** | **☐** | **☐** |
| This policy would be effective in decreasing carbon dioxide emissions to limit climate change | **☐** | **☐** | **☐** | **☐** | **☐** |
| This policy would be fair | **☐** | **☐** | **☐** | **☐** | **☐** |
| This policy would be too expensive to be feasible | **☐** | **☐** | **☐** | **☐** | **☐** |
| This policy would be too risky to be feasible | **☐** | **☐** | **☐** | **☐** | **☐** |
| This policy would be politically feasible | **☐** | **☐** | **☐** | **☐** | **☐** |
| This policy would affect me directly | **☐** | **☐** | **☐** | **☐** | **☐** |
| This policy would restrict freedom unnecessarily | **☐** | **☐** | **☐** | **☐** | **☐** |
| In the long term, this policy would create more jobs than it eliminates  | **☐** | **☐** | **☐** | **☐** | **☐** |
| This policy would decrease our reliance on foreign oil | **☐** | **☐** | **☐** | **☐** | **☐** |
| I trust the officials, scientists, and companies that would carry out this policy | **☐** | **☐** | **☐** | **☐** | **☐** |
| This policy would decrease energy prices in the long term | **☐** | **☐** | **☐** | **☐** | **☐** |

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Recently, you may have noticed that climate change has been getting much attention in the news. Climate change refers to the idea that the world’s average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world’s climate may change as a result. What do you think? Do you think that climate change is happening?

☐ Yes -- Definitely

☐ Yes -- Probably

☐ No -- Probably

☐ No -- Definitely

Assuming climate change is happening, do you think it is…

☐ Caused mostly by human activities

☐ Caused mostly by natural changes in the environment

☐ Caused by both human activities and natural changes

☐ None of the above because climate change isn’t happening

☐ Don’t know

☐ Other (please specify): \_\_\_\_\_\_\_\_\_

Which comes closer to your own view?

☐ Most scientists think climate change is happening

☐ Most scientists think climate change is not happening

☐ There is a lot of disagreement among scientists about whether or not climate change is happening

☐ I don’t know enough to say

[PAGE BREAK]

How important is the issue of climate change to you personally?

☐ Very important

☐ Somewhat important

☐ Not too important

☐ Not at all important

How sure are you that climate change is happening?

☐ Extremely sure

☐ Very sure

☐ Somewhat sure

☐ Not at all sure

[PAGE BREAK]

How would you describe your political beliefs?

☐ Very Liberal

☐ Liberal

☐ Slightly Liberal

☐ Moderate

☐ Slightly Conservative

☐ Conservative

☐ Very Conservative

What is your gender?

 ☐ Male

 ☐ Female

 ☐ Other

What is your age? \_\_\_\_\_ [numeric validation]

[PAGE BREAK]

What is the highest level of education you have attained?

☐ Some schooling, but no diploma or degree

☐ High school diploma or GED

☐ Some college

☐ College degree

☐ Some graduate school

 ☐ Graduate degree

How many college-level courses have you taken in the physical or natural sciences (such as physics, chemistry, biology, etc.)?

☐ 0

☐ 1

☐ 2

☐ 3

☐ 4 or more

During 2016, what was your yearly household income before taxes? Your best estimate is fine.

☐ None

☐ < $20,000

☐ $20,000 - $40,000

☐ $40,000 - $80,000

☐ $80,000 - $120,000

 ☐ $120,000 - $200,000

 ☐ > $200,000

What is your ZIP code?

\_\_\_\_\_\_ [Zip code validation]

[PAGE BREAK]

Do you have any additional thoughts or comments about the survey that you would like to share with us?

[open ended; not required]

Thank you for participating!

Your unique completion code is: [survey taker is presented with a unique completion code]

# **Reformation Survey Instrument**

March 2016

Dear Participant,

Please complete this survey on a relevant public policy issue. The survey is anonymous, and no one will know what answers you give. This brief survey should take no more than 15 minutes to complete.

Thank you for your time and help with this effort.

If you have any questions, please do not hesitate to send me an email at: survey.iub@gmail.com.

Sincerely,

Dr. Shahzeen Attari

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**VIGNETTES** – participants are shown only one of six vignettes (indicated as V1-V6) at random followed by the rest of the survey

Please read the paragraphs below and answer the questions that follow:

Common language: You are attending a talk by a leading climate researcher. He has been publishing scholarly articles in the field of climate science since 1974, and has over 150 publications in top journals, including many in *Science* and *Nature*.

The researcher explains how an individual’s actions can collectively have a large impact on the environment. He gives examples of these actions, such as air travel and amount of energy used in the home. He also explains how these actions can have negative effects on the environment. Near the end of the talk, the researcher gives advice to the audience on how they can reduce their own energy use. He gives examples such as flying less, using less energy at home, and taking public transportation. He urges the audience to make these changes.

V1 Travel no repentance: You later find out that the researcher flew across the country to give the talk that you attended, and that he regularly flies to give talks all over the world, even though avoiding flying would reduce his carbon footprint.

V2 Travel some repentance: You later find out that the researcher used to fly to give talks all over the world. However, he now flies only twice a year to give talks, and participates in the rest by videoconferencing, which has reduced his carbon footprint.

V3 Travel absolute repentance: You later find out that the researcher used to fly to give talks all over the world. However, he has now given up flying altogether. Instead, he participates in events by videoconferencing, which has significantly reduced his carbon footprint.

V4 Home no repentance: You later find out that the researcher consumes much more energy than the average person at home. He has a large house with a high home energy bill, and does not invest in clean energy or in energy efficient appliances, even though investment in energy efficient appliances would reduce his carbon footprint.

V5 Home some repentance: You later find out that the researcher used to consume much more energy than the average person at home. He had a large house with a high home energy bill, and did not choose to invest in clean energy or in energy efficient appliances. However, he has now installed energy efficient light bulbs in his home. He is also very active in decreasing his home energy use by changing his thermostat settings, which has reduced his carbon footprint.

V6 Home absolute repentance: You later find out that the researcher used to consume much more energy than the average person at home. He had a large house with a high home energy bill, and did not choose to invest in clean energy or in energy efficient appliances. However, he has now moved into a smaller home and has made energy efficient upgrades to his home including installing energy efficient light bulbs, better attic insulation, and better windows. He is also very active in decreasing his home energy use by changing his thermostat settings, and has since installed solar panels on his roof, which has significantly reduced his carbon footprint.

Rest of Survey: Based on the advice provided by the researcher,please check which of the following actions you would be willing to incorporate in your life. *(Check all that apply).*

☐ Fly less

☐ Use less energy in my home

☐ Take public transportation more often

☐ Change no actions, because I already have adopted these behaviors

☐ Change no actions

☐ Other (please specify): \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

**ATTITUDES** – all participants are asked the following questions, statements are shown in random order.

Based on the previous paragraph, for each statement below please indicate how strongly you agree or disagree with the statement:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
| I believe that the researcher’s behavior is consistent with his advice | **☐** | **☐** | **☐** | **☐** | **☐** |
| The researcher’s advice will probably not influence my behavior | **☐** | **☐** | **☐** | **☐** | **☐** |
| I believe the researcher’s advocacy is sincere | **☐** | **☐** | **☐** | **☐** | **☐** |
| I do not trust the researcher’s authority with respect to climate science | **☐** | **☐** | **☐** | **☐** | **☐** |
| I believe that the researcher has good reasons for his behavior | **☐** | **☐** | **☐** | **☐** | **☐** |
| I doubt the researcher’s credibility | **☐** | **☐** | **☐** | **☐** | **☐** |
| I believe that the researcher provides quality advice  | **☐** | **☐** | **☐** | **☐** | **☐** |

[PAGE BREAK]

For each statement below, please indicate how strongly you agree or disagree with the statement:

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
|  | Strongly Agree | Agree | Neutral | Disagree | Strongly Disagree |
| I always practice what I preach | **☐** | **☐** | **☐** | **☐** | **☐** |
| Scientists should practice what they preach | **☐** | **☐** | **☐** | **☐** | **☐** |
| I would trust an overweight medical doctor to give dieting advice | **☐** | **☐** | **☐** | **☐** | **☐** |
| Scientists know better than anyone else what is good for the public | **☐** | **☐** | **☐** | **☐** | **☐** |
| It is important for scientists to get research done even if they displease people by doing it | **☐** | **☐** | **☐** | **☐** | **☐** |
| Climate scientists need to influence policy decisions that affect how society responds to climate change | **☐** | **☐** | **☐** | **☐** | **☐** |

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**4.** Recently, you may have noticed that climate change has been getting some attention in the news. Climate change refers to the idea that the world’s average temperature has been increasing over the past 150 years, may be increasing more in the future, and that the world’s climate may change as a result. What do you think? Do you think that climate change is happening?

☐ Yes -- Definitely

☐ Yes -- Probably

☐ No -- Probably

☐ No -- Definitely

**5.** Assuming climate change is happening, do you think it is…

☐ Caused mostly by human activities

☐ Caused mostly by natural changes in the environment

☐ Caused by both human activities and natural changes

☐ None of the above because climate change isn’t happening

☐ Don’t know

☐ Other (please specify): \_\_\_\_\_\_\_\_\_

**6.** Which comes closer to your own view?

☐ Most scientists think climate change is happening

☐ Most scientists think climate change is not happening

☐ There is a lot of disagreement among scientists about whether or not climate change is happening

☐ I don’t know enough to say

[PAGE BREAK]

**7.** How important is the issue of climate change to you personally?

☐ Very important

☐ Somewhat important

☐ Not too important

☐ Not at all important

**8.** How sure are you that climate change is happening?

☐ Extremely sure

☐ Very sure

☐ Somewhat sure

☐ Not at all sure

[PAGE BREAK]

ATTENTION QUESTION

Thoughts and Motivations

This page is a test to confirm that you are reading the instructions carefully. We are simply testing whether or not you are actually reading this survey. Please ignore the text of the following question, and type in the word “reader” as your answer. Thank you for reading carefully.

On average, how many times a day do you think about things you need to do? Please give your best estimate: [no validation]

**ENERGY USE**

**9.** What is the average monthly electricity bill (in $) for your household?

☐ under $20

☐ about $20

☐ about $40

☐ about $60

☐ about $80

☐ about $100

☐ about $120

☐ about $200

☐ above $200

☐ Do not know

☐ Not applicable

☐ I don’t pay my bill

**10.** On average, how many miles do you drive in one week? \_\_\_\_\_ [numeric validation]

**11.** On average, what is the fuel economy of your primary car in miles per gallon? *(Please enter 0 if you do not use a car.)*

\_\_\_\_\_\_\_ [numeric validation]

**12.** Please estimate how many round-trip flights you took in 2015:

\_\_\_\_\_ [numeric validation]

**13.** On average, how many days a week do you consume red meat or dairy?\_\_\_\_\_ [numeric validation; 0-7]

[PAGE BREAK]

**\*\*\*DEMOGRAPHICS**

**14.** How many people are there in your household (including yourself)? \_\_\_\_\_ [numeric validation]

**15.** How many children do you have? \_\_\_\_\_ [numeric validation]

**16.** How would you describe your political beliefs?

☐ Very Liberal

☐ Liberal

☐ Slightly Liberal

☐ Moderate

☐ Slightly Conservative

☐ Conservative

☐ Very Conservative

**17.** What is your gender?

 ☐ Male

 ☐ Female

 ☐ Other

**18.** What is your age? \_\_\_\_\_ [numeric validation]

[PAGE BREAK]

**19**. Do you have any degrees in the physical or natural sciences (such as physics, chemistry, biology, etc.)?

☐ Yes

☐ No

**20.** What is the highest level of education you have attained?

☐ Some schooling, but no diploma or degree

☐ High school diploma or GED

☐ Some college

☐ College degree

☐ Some graduate school

 ☐ Graduate degree

**20.** During 2015, what was your yearly household income before taxes? Your best estimate is fine.

☐ None

☐ < $20,000

☐ $20,000 - $40,000

☐ $40,000 - $80,000

☐ $80,000 - $120,000

 ☐ $120,000 - $200,000

 ☐ > $200,000

**21.** What is your ZIP code?

\_\_\_\_\_\_ [Zip code validation]

[PAGE BREAK]

**22.** Do you have any additional thoughts or comments about the survey that you would like to share with us?

[open ended; not required]

Thank you for participating!

Your unique completion code is: [survey taker is presented with a unique completion code]

# **Expert Elicitation**

Data collected on December 2016

**What are five policies that you believe would be effective in stabilizing greenhouse gas concentrations?**

**Expert 1.**

1. Carbon tax
2. Clean energy mandate
3. Cap and trade
4. Energy efficiency standards
5. Renewable energy subsidies

**Expert 2.**

1. Ban coal
2. Ban internal combustion engine
3. Ban natural gas
4. Ban consumption of beef
5. Ban airplane travel.

**Expert 3.**

1. Creating a rigorous industrial policy to encourage green technologies (see: Rethinking Capitalism: Economics and Policy for Sustainable and Inclusive Growth, Michael Jacobs and Mariana Mazzucato, Wiley, 2016)
2. An effective tax on carbon.  This can be accomplished through a direct carbon tax or by cap and trade or by a Citizens Climate Lobby “fee and dividend” scheme.
3. Clean Power Plan or the equivalent that gives individual states and industries time to move away from their dependence on extreme carbon sources like coal.
4. Policy that encourages the utilization of carbon neutral resources – feed in tariff, net metering, neighborhood and community renewable energy pooling, etc.
5. International cooperation and collaboration on reducing GHGs – Paris COP21 is a superb example.

**Expert 4.**

In a ranked order, most to least effective:

1. Auto emission standards (e.g. CAFE)
2. Nuclear based electricity generation
3. Distributed generation
4. Solar and wind electricity generation
5. Tax on carbon at end-user

You used the verb “effective”. To me that means it must be implementable. Global cap and trade is not workable in this regard. CCS might help but it is too small a scale. The only truly effective solution to GHG emission is to stop emitting.

**Expert 5.**

1. Carbon tax
2. Carbon tax
3. Carbon tax
4. Carbon tax
5. Carbon tax

I honestly think that implementing a international carbon tax would be THE most efficient way to stabilize GHG emissions. Realistically we are miles away from that happening. And, carbon taxes do have a series of equity issues associated with them. That said, a more realistic approach would be (focusing on the top GHG emitting sectors) a regional/national/international cap and trade system for: 1) Energy Generation, 2) Transportation (Light Duty/Heavy Duty Vehicle Fleet, Air, Rail and Maritime), 3) Industry (top emitters are Aluminum, Steel and Cement and of course Refineries), 4) Agriculture (methane emissions and fertilizers).

**Expert 6.**

Can’t think of 5 that would be effective in isolation… but here are some that I would include on the short list:

1. Carbon tax
2. GHG Cap and Trade
3. Govt incentives for expansion of alternatives to fossil fuels – wind, solar, hydrogen fuel cells
4. Govt incentives for R&D and expansion of carbon dioxide capture and storage

**Expert 7.**

I am having difficulty with this because of vocabulary.  I see three interpretations.

The first is about setting goals – e.g., we want to reduce CO2 emissions by 30 percent by 2030, we are going to reduce emissions from agriculture by 25 percent by 2050.

The second is behavioral/technical and it has to do with the means by which we make those reductions – e.g., we need more fuel efficient automobiles, we need to change the level of thermostats, we need to expand forest cover to sequester more carbon.

The third is the instruments by which we change behavior, including technological choices – e.g., carbon taxes, efficiency regulations and such.

I hesitate to answer the question because I am unsure how you are using the term.  I use the term “policy” to indicate the goal – we have a policy of reducing emission.  Or to use your example – a policy to stabilize GHG concentrations.  I refer to the third interpretation above as an implementation approach, including policy instrument choice.

Often, I note, that folks confuse technological and behavioral strategies with policy instruments.  Ask some folks what their instrument is for reducing emissions and they might answer “wind power.”  That is not a policy instrument – it is a technology.  You still need a policy instrument to induce increased adoption of the wind power.

**Expert 8.**

1. Any C&T or similar policies,
2. CAFE standards (including expansion to other types)
3. subsidies for renewable energy including cross-state purchases of renewable credits
4. subsidization of public transportation

I want to emphasize that if one were to solely look at which sector(s) produce the most GHG emissions, one might come up with a different list. The above list takes sector distribution into account (i.e. ~25% of GHG from transportation, more than that in power generation...) but also which sectors are more amenable to policy interventions. That is, some sectors are more amenable to policy interventions than others and there is current traction for some policies. Other sectors may have considerable potential for increased efficiency or reduced GHG emissions, but there is less likelihood that a policy in those sectors is likely to be implemented in the near term.

So if you're doing one of your sneaky "Scientists think X but really Y is true, scientists are dumb and are hypocrites!" then understand that my answers are not intended to be a 1-to-1 link to which sectors produce most GHG emissions or where inefficiencies exist.

**Expert 9.**

I’m afraid the question is still too ambiguous for me. It’s not just a matter of stabilizing atmospheric concentration levels of GHGs, but stabilizing them at some presumptively “safe” level, while at the same time ensuring reliable energy supplies for continuing economic development (especially in LDCs). That’s why I often refer to climate change not as *a* problem, but as a *complex of* (complex) problems. If you have in mind technically feasible and cost-effective (but not necessarily politically feasible) near-term policies that would move us substantially in the direction of stabilizing GHG concentration levels in accordance with Paris Agreement goals (no more than 2 degrees (C) increase in GMTs but preferably under 1.5 degrees (C), then I would recommend the following as “effective” policies:

1. An upstream (point of extraction) carbon tax, based on the estimated social cost of carbon;
2. Increasing CAFE standards for motor vehicle emissions;
3. Policies favoring nuclear power development;
4. More stringent energy efficiency requirements in building codes;
5. Increasing tax credits plus low-interest loans to subsidize installation of solar and wind, while reducing subsidies (including implicit subsidies) for fossil fuels.

Meanwhile, I would increase funding for basic R&D of renewables in view of longer-term policies.

**Expert 10.**

This question is actually quite hard. A number of issues comes to my mind; it is difficult for me to think in terms of effectiveness without defining a more specific social-political context. Policies vary in their causal relationships to **emissions and absorption** (and direct and indirect effects related to both), as well as with short and long-term effects and effectiveness. One could go about by focusing on sectors, regions, or the causal chain triggered by policies. Here is a ‘mix’ of everything:):

-Policies that target **demand** (e.g., various types of consumption), **incentives** (e.g., land use change, certification), and/or **sanctions** (e.g., fines, embargo); some may be effective on the short run (e.g., curbing deforestation), but most may be more effective on the long run;

-Policies targeted to, directly and indirectly, promote **technological transitions** in the **energy** and **transportation** industries may have some punctual short-term effects, but in both cases require med- to long-term transitions (of course this depends on the type of technology, region or sector of society);

-Policies that target **storage technology** (e.g., carbon storage, etc.), **absorption technology** (i.e., iron fertilization), and **avoided emissions** (e.g.,  conservation land use in peat, forests, wetlands); again these include a combination of med- and long-term effectiveness.

I guess no magic bullet as we all know ☺

**Expert 11.**

A carbon tax

Elimination of subsidies for fossil fuels

Strong renewables quotas for utilities

Feed-in tariffs

Emissions limits on power plants and vehicles

**Expert 12.**

A combination of:

1. quantitative restrictions on carbon emissions from point-source industrial and utility emitters, implemented with tradable permits (like the European emission trading system (ETS), and the Cap and Trade program now being instituted in China).
2. Fuel taxes on non-electricity energy use in buildings (commercial and residential), the transportation sector, and the farm sector.
3. Incentives of various types for renewables.
4. A major commitment to R&D on advanced battery storage systems.
5. A major commitment to R&D on alternative energy sources, including fusion power.

Note: the first-best prescription that environmental economists would recommend is just one policy: either a carbon tax levied on primary energy producers, or a binding cap for CO2 emissions levied on primary energy producers (coal, oil, and ng producers), combined with a tariff on the imports of crude oil, coal, and natural gas. This would be the equivalent of a broad-based consumption tax on primary energy use. That is, the consumption of oil, coal, and natural gas, whether domestically produced or imported, would be heavily taxed. The large rise in energy prices from taxing primary consumption would ripple up the energy supply chain, and throughout the entire economy, creating private incentives for all of the actions suggested in (1) through (5) above. Unfortunately, the designers of every emissions trading program start out with the hope that the program will be implemented on primary producers, but the system ends up being implemented at the next level up the supply chain, i.e, on industrial energy users and utility companies (as suggested in 1 above). This is the structure of the European Emissions trading system, and the new system being implemented in China. (it was also the structure of the cap and trade program which Obama proposed in his first term). I assume it is politically unacceptable to raise energy prices to major industrial sectors and utility companies – what taxing primary energy would do. Implementing cap and trade programs at this stage in the supply chain reduces the financial loss to these firms, because tradable permits can be grandfathered.

# **5. References**

1 Attari, S. Z., Krantz, D. H. & Weber, E. U. Statements about climate researchers’ carbon footprints affect their credibility and the impact of their advice. *Climate Change* **138**, 325-338, doi:10.1007/s10584-016-1713-2 (2016).